Claims

1. Method for seamless handover of mobile devices in heterogeneous networks in which method a mobile device (10) is moved between different topological network locations (30/31/32/33) and transmits and/or receives data by means of different network access technologies without the data transfer between a Client IP application (11), running on the mobile device (10), and a Server IP application (21) being interrupted, characterised in

that the Client IP application (11) of the mobile device (10) makes a request with first data units to a client-service module (12),

that the client-service module (12) creates second data units based on the received first data units and makes a request to a server-service module (22) with the second data units,

that the server-service module (22) creates third data units based on the received second data units and makes a request to the Server IP application (21) with the third data units to handle the data exchange between the Client IP application (11) and the Server IP application (21).

2. Method according to claim 1, characterised in that the Client IP application (11) of the mobile device (10) makes the request with first data units to the client-service module (12) by means of a first socket.

3. Method according to claim 1 or 2, characterised in that the client-service module (12) makes the request to the server-service module (22) with the second data units by means of a second socket.

4. Method according to any one of the claims 1 to 3, characterised in that the server-service module (22) makes the request to the Server IP application (21) with the third data units by means of a third socket.

5. Method according to any one of the claims 1 to 4, characterised in

that the Server IP application (21) makes a reply with fourth data units to the server-service module (22),

that the server-service module (22) creates fifth data units based on the received fourth data units and makes a reply to the client-service module (12) with the fifth data units,

that the client-service module (12) creates sixth data units based on the received fifth data units and makes a reply to the Client IP application (11) with the fifth data units.

6. Method according to any one of the claims 1 to 5, characterised in

that the Server IP application (21) makes a request with seventh data units to the server-service module (22),

that the server-service module (22) creates eighth data units based on the received seventh data units and makes a request to the client-service module (12) with the eighth data units,

that the client-service module (12) creates ninth data units based on the received eighth data units and makes a request to the Client IP application (11) with the ninth data units.

7. Method according to claim 6, characterised in that the Server IP application (21) makes the request with seventh data units to the server-service module (22) by means of a fourth socket.

8. Method according to claim 6 or 7, characterised in that the server-service module (22) makes the request to the client-service module (12) with the eighth data units by means of a fifth socket.

9. Method according to any one of the claims 6 to 8, characterised in that the client-service module (12) makes the request to the Client IP application (11) with the ninth data units by means of a sixth socket.

10. Method according to any one of the claims 6 to 9, characterised in

that the Client IP application (11) of the mobile device (10) makes a reply with tenth data units to the client-service module (12),

that the client-service module (12) creates eleventh data units based on the received tenth data units and makes a reply to the server-service module (22) with the eleventh data units,

that the server-service module (22) creates twelfth data units based on the received eleventh data units and makes a reply to the Server IP application (21) with the twelfth data units.

11. Method according to any one of the claims 1 to 10, characterised in that the data transfer is realized by means of IEEE 802.11 and/or IEEE 802.16 and/or GPRS and/or EDGE and/or UMTS and/or CDMA2000 and/or Bluetooth and/or ZigBee and/or PSTN and/or ADSL and/or Ethernet and/or Token Ring and/or FDDI.

12. Method according to any one of the claims 2 to 11, characterised in that the socket used is connection-oriented.

13. Method according to any one of the claims 2 to 11, characterised in that the socket used is connectionless.

14. Method according to any one of the claims 1 to 13, characterised in that the client-service module (12) is installed on the same mobile device (10) running the Client IP application (11).

15. Method according to any one of the claims 2 to 14, characterised in that the client-service module (12) provides at least a server application emulation interface comprising sockets and server sockets used to exchange data with the Client IP application (11) and bound to the loopback address used to communicate with the Client IP application (11), and a client application

emulation interface comprising sockets and server sockets used to exchange data with the server-service module (22) and bound to the IP address provided by the physical interface currently selected by the client-service module (12).

16. Method according to any one of the claims 1 to 13, characterised in that the client-service module (12) is installed on any additional mobile device on the same local area network as the Client IP application mobile device (10).

17. Method according to the claim 16, characterised in that the client-service module (12) provides at least a server application emulation interface comprising sockets and server sockets used to exchange data with the Client IP application (11) and bound to the IP address provided by a first physical interface used to communicate with the Client IP application (11), and a client application emulation interface comprising sockets and server sockets used to exchange data with the server-service module (22) and bound to the IP address provided by a second physical interface currently selected by the client-service module (12).

18. Method according to the claim 15 or 17, characterised in that the server-service module (22) provides at least a server application emulation interface comprising sockets and server sockets used to exchange data with the client-service module (12) and a client application emulation interface comprising sockets and server sockets used to exchange data with the Server IP application (21).

19. Method according to any one of the claims 1 to 18, characterised in that the server-service module (22) is installed on the same device (20) running the Server IP application (21).

20. Method according to any one of the claims 1 to 18, characterised in that the server-service module (22) is installed on a different device of the same network as the device (20) running the Server IP application (21).

21. Method according to any one of the claims 1 to 18, characterised in that the server-service module (22) is installed on any Internet node.

22. Method according to any one of the claims 1 to 21, characterised in that a plurality of Server IP applications (21) resident on one or more devices is handled by the same server-service module (22).

23. Method according to any one of the claims 1 to 22, characterised in that a plurality of Client IP applications (11) resident on one or more mobile devices is handled by the same client-service module (12).

24. Method according to any one of the claims 1 to 23, characterised in that the client-service module (12) is connected simultaneously to a plurality of server-service modules (22).

25. Method according to any one of the claims 1 to 24, characterised in that a plurality of client-service modules (12) is connected simultaneously to a single server-service module (22).

26. Method according to any one of claims 15 or 17 and claim 18, characterised in

that the Server IP application (21) provides a set of server service server sockets listening on ports known by the Client IP application (11) and by the client-service module (12) and by the server-service module (22),

that the client-service module (12) provides a set of server service emulator server sockets listening on the same ports as the Server IP application (21) services and creates, for each service request received from the Client IP application (11), a client request emulation socket with the server-service module (22),

that the server-service module (22) provides a set of server service emulator server sockets listening on a set of ports known by the client-service module (12) and creates, for each service request received from the client-service module (12), a client request emulation socket with the Server IP application (21), on the port of the service that the Client IP application (11) wants to use.

27. Method according to the claim 26, characterised in

that the Client IP application (11) provides a set of client service server sockets listening on ports known by the Server IP application (21) and by the client-service module (12) and by the server-service module (22),

that the server-service module (22) provides a set of client service emulator server sockets listening on the same ports as the Client IP application (11) services and creates, for each service request received from the Server IP application (21), a server request emulation socket with the client-service module (12),

that the client-service module (12) provides a set of client service emulator server sockets listening on a set of ports known by the server-service module (22) and creates, for each service request received from the server-service module (22), a server request emulation socket with the Client IP application (11), on the port of the service that the Server IP application (21) wants to use.

28. Method according to the claim 27, characterised in that a plurality of client-service modules (12) of two or more mobile devices, providing client service emulator server sockets on the same ports, is connected to the same server-service module (22) and the client application emulation interface sockets of the server-service module (22) are bound to different Virtual IP addresses created and/or allocated by it.

29. Method according to any one of the claims 1 to 28, characterised in

that the server-service module (22) provides at least one control server socket listening on a port known by the client-service module (12),

that the client-service module (12), to exchange data with the server-service module (22), creates at least one control socket with the server-service module (22).

30. Method according to any one of the claims 1 to 29, characterised in that the client-service module (12) periodically checks the mobile device, in which it is installed, for available and configurable physical network interfaces and creates a lookup table with the available and configurable ones.

31. Method according to claim 30, characterised in

that, with a sudden or planned change or update of a physical network interface that causes a modification of the IP address currently used by the client-service module (12) to access the server-service module (22), the data transfer between the Client IP application (11) and the Server IP application (21) is suspended but, in order to provide the seamless handover, kept up until the client-service module (12) has obtained a new IP address using the lookup table and has established a new network connection with the server-service module (22),

that the data transfer between the Client IP application (11) and the Server IP application (21) is resumed after that the client-service module (12) and the server-service module (22) have completed the handshaking for the switching procedure from the old IP address to the new one and, in case of a sudden IP transition, after that the client-service module (12) and the server-service module (22) have resent the data not received by the other end.

32. Method according to claim 31, characterised in that the client-service module (12) automatically changes and updates the physical network interface currently used to access the server-service module (22) on the basis of information retrieved from the lookup table.

33. Method according to the claim 32, characterised in that the criteria for the automatic change and/or update of the physical network interface currently used by the client-service module (12) to access the server-service module (22) are defined by the user.

34. Method according to claim 31, characterised in that a change or an update of the physical network interface currently used by the client-service module (12) to access the server-service module (22) is initiated by the user.

35. Method according to any one of the claims 1 to 34, characterised in that the client-service module (12) and/or the server-service module (22) are OSI Layer 7 applications and are created as platform independent applications.

36. Method according to claim 35, characterised in that the client-service module (12) and/or the server-service module (22) are at least in part composed by Java modules.

37. System for seamless handover of mobile devices in heterogeneous networks, in which a mobile device has at least one physical network interface and is movable between different topological network locations and is able to transmits and/or receives data by means of different network access technologies without the data transfer between a Client IP application (11), running on the mobile device, and a Server IP application (21) being interrupted, characterised in

that a client-service module (12) comprises means for communicating with the Client IP application (11) and with a server-service module (22),

that the client-service module (12) comprises means to create second data units based on first data units received from the Client IP application (11) and to exchange them with the server-service module (22),

that the server-service module (22) comprises means for communicating with the Server IP application (21) and with the client-service module (12),

that the server-service module (22) comprises means to create third data units based on the second data units received from the client-service module (12) and to exchange them with the Server IP application (21).

38. System according to the claim 37, characterised in

that the server-service module (22) comprises means to create fifth data units based on fourth data units received from the Server IP application (21) and to exchange them with the client-service module (12),

that the client-service module (12) comprises means to create sixth data units based on the fifth data units received from the server-service module (22) and to exchange them with the Client IP application (11).

39. System according to the claim 37 or 38, characterised in

that the Server IP application (21) comprises means to make requests with seventh data units to the server-service module (22),

that the server-service module (22) comprises means to create eighth data units based on the seventh data units received from the Server IP application (21) and to exchange them with the client-service module (12),

that the client-service module (12) comprises means to create ninth data units based on the eighth data units received from the server-service module (22) and to exchange them with the Client IP application (11).

40. System according to any one of the claims 37 to 39, characterised in

that the Client IP application (11) comprises means to make replies with tenth data units to a client-service module (12),

that the client-service module (12) comprises means to create eleventh data units based on the tenth data units received from the Client IP application (11) and to exchange them with the server-service module (22),

that the server-service module (22) comprises means to create twelfth data units based on the eleventh data units received from the client-service module (12) and to exchange them with the Server IP application (21).

41. System according to any one of the claims 37 to 40, characterised in

that the client-service module (12) comprises means to provide server service emulator server socket accepting service requests coming from the Client IP application (11) and to make service requests to the server-service module (22) through a client request emulation socket,

that the client-service module (12) comprises means to make service requests to the server-service module (12) through at least a control socket,

that the server-service module (22) comprises means to provide server service emulator server sockets accepting service requests coming from the client-service module (12) and to make service requests to the Server IP application (21) through a client request emulation socket,

that the server-service module (22) comprises means to provide at least a control server socket accepting service requests coming from the client-service module (12),

that the Server IP application (21) comprises means to provide server service server sockets accepting service request coming from the server-service module (22).

42. System according to the claim 41, characterised in

that the Client IP application (11) comprises means to provide client service server sockets accepting service requests coming from the client-service module (12),

that the client-service module (12) comprises means to provide client service emulator server sockets accepting service requests coming from the server-service module (22) and to make service requests to the Client IP application (11) through a server request emulation socket,

that the server-service module (22) comprises means to provide client service emulator server sockets accepting service requests coming from the Server IP application (21) and to make service requests to the client-service module (12) through a server request emulation socket,

that the Server IP application (21) comprises means to make service requests to the server-service module (22).

43. System according to any one of the claims 37 to 42, characterised in that the system comprises the client-service module (12) installed on the same mobile device (10) as the Client IP application (11).

44. System according to any one of the claims 37 to 43, characterised in that the client-service module (12) comprises at least a server application emulation interface composed of sockets and server sockets used to exchange data with the Client IP application (11) and bound to the loopback address used to communicate with the Client IP application (11), and a client application emulation interface composed of sockets and server sockets used to exchange data with the server-service module (22) and bound to the IP address provided by the physical interface currently selected by the client-service module (12).

45. System according to any one of the claims 37 to 42, characterised in that the system comprises the client-service module (12) installed on any additional mobile device on the same local area network as the Client IP application mobile device (10).

46. System according to claim 45, characterised in that the client-service module (12) comprises at least a server application emulation interface composed of sockets and server sockets used to exchange data with the Client

IP application (11) and bound to the IP address provided by a first physical interface used to communicate with the Client IP application (11), and a client application emulation interface composed of sockets and server sockets used to exchange data with the server-service module (22) and bound to the IP address provided by a second physical interface currently selected by the client-service module (12).

47. System according to the claim 44 or 46, characterised in that the server-service module (22) comprises at least a server application emulation interface composed of sockets and server sockets used to exchange data with the client-service module (12) and a client application emulation interface composed of sockets and server sockets used to exchange data with the Server IP application (21).

48. System according to the claim 47, characterised in that a plurality of client-service modules (12) of two or more mobile devices, providing client service emulator server sockets on the same ports, is connected to the same server-service module (22) and the client application emulation interface sockets of the server-service module (22) are bound to different Virtual IP addresses created and/or allocated by it.

49. System according to any one of the claims 37 to 48, characterised in that the system comprises the server-service module (22) installed on the same device (20) as the Server IP application (21).

50. System according to any one of the claims 37 to 48, characterised in that the system comprises the server-service module (22) installed on a different device of the same network as the device (20) running the Server IP application (21).

51. Method according to any one of the claims 37 to 48, characterised in that the system comprises the server-service module (22) installed on any Internet node.

52. System according to any one of the claims 37 to 51, characterised in that a plurality of Server IP applications (21) resident on one or more devices is handled by the same server-service module (22).

53. System according to any one of the claims 37 to 52, characterised in that a plurality of Client IP applications (11) resident on one or more mobile devices is handled by the same client-service module (12).

54. System according to any one of the claims 37 to 53, characterised in that the client-service module (12) is connected simultaneously to a plurality of server-service modules (22).

55. System according to any one of the claims 37 to 54, characterised in that a plurality of client-service modules (12) is connected simultaneously to a single server-service module (22).

56. System according to any one of the claims 37 to 55, characterised in that the client-service module (12) and/or the server-service module (22) are OSI Layer 7 applications and are created as platform independent applications.

57. System according to claim 56, characterised in that the client-service module (12) and/or the server-service module (22) are at least in part composed by Java modules.

58. A computer program product comprising a computer-readable medium with computer program code means contained therein for control of one or more processors of a computer-based system for seamless handover of mobile devices in heterogeneous networks, characterized in that the computer program code implements a client-service module (12) according to any one of the claims 1 to 57.

59. A computer program product comprising a computer-readable medium with computer program code means contained therein for control of one or more processors of a computer-based system for seamless handover of

mobile devices in heterogeneous networks, characterized in that the computer program code implements a server-service module (22) according to any one of the claims 1 to 57.

60. A computer program product which is able to be loaded in the internal memory of a digital computer and comprises software code sections with which the steps according to any one of the claims 1 to 57 are able to be carried out when the product runs on a computer.